

**U.S. ENVIRONMENTAL PROTECTION AGENCY  
NATIONAL AIR AND RADIATION ENVIRONMENTAL LABORATORY  
540 S. MORRIS AVE., MONTGOMERY, AL 36115  
TH ANALYSES**

**REPORT OF SAMPLE DELIVERY GROUP #1200016**

Project: Dimock Residential GW Site, Dimock, PA - Follow-up work  
Analysis method: Actinides (Thorium) by Extraction Chromatography  
Report ID: 1200016-TH  
Report type: Original  
Date reported: 06/13/2012  
Total pages in report: 14

**SAMPLES**

<b>NAREL Sample #</b>	<b>Client Sample ID</b>	<b>Location</b>	<b>Matrix</b>	<b>Date Collected</b>	<b>Date Received</b>
B2.05495G	FB22	PA:DIMOCK	WATER-DRINKING	05/22/2012	05/23/2012
B2.05496H	HW64	PA:DIMOCK	WATER-DRINKING	05/22/2012	05/23/2012
B2.05497J	FB23	PA:DIMOCK	WATER-DRINKING	05/23/2012	05/24/2012
B2.05498K	HW63Z	PA:DIMOCK	WATER-DRINKING	05/23/2012	05/24/2012
B2.05499L	HW62	PA:DIMOCK	WATER-DRINKING	05/22/2012	05/24/2012
B2.05500K	HW63	PA:DIMOCK	WATER-DRINKING	05/23/2012	05/24/2012

**EXCEPTIONS**

1. **Packaging and shipping** – No problems were observed.
2. **Documentation** – No problems were observed.
3. **Sample preparation** – No problems were encountered.
4. **Analysis** – No problems were encountered.
5. **Holding times** – No holding times were specified.

**QUALITY CONTROL**

1. **QC samples** – All QC analysis results met NAREL acceptance criteria.
2. **Yields** – All chemical yields were within acceptance limits.
3. **Instruments** – Response and background checks for all instruments used in these analyses met NAREL acceptance criteria.

## CERTIFICATION

I certify that this data report complies with the terms and conditions of the Quality Assurance Project Plan, except as noted above. Release of the data contained in this report has been authorized by the Director of the Center for Environmental Radioanalytical Laboratory Science and the NAREL Quality Assurance Manager, or their designees, as verified by the following signatures.

Mary Wisdom 6-18-12  
Mary F. Wisdom Date  
Quality Assurance Manager, NAREL

Cynthia White 6-14-12  
Cynthia A. White Date  
Acting Director, Center for Environmental Radioanalytical  
Laboratory Science

## GENERAL INFORMATION

### SAMPLE TYPES

BLD	Blind sample
FBK	Field blank
SAM	Normal sample

### ANALYSIS QC TYPES

ANA	Normal analysis
DUP	Laboratory duplicate
LCS	Laboratory control sample (blank spike)
MS	Matrix spike
MSD	Matrix spike duplicate
RBK	Method blank
STD	External standard (used for $^{228}\text{Ra}$ yield determination)

### QUALITY INDICATORS

RPD	Relative Percent Difference
%R	Percent Recovery
Z	Number of standard deviations by which a QC measurement differs from the expected value

### RADIOCHEMICAL DATA

Radiochemical analyses usually require the subtraction of an instrument background measurement result from a gross sample measurement result. Both values are positive, but when the sample activity is low, random variations in the two measurements can cause the gross value to be less than the background, resulting in a measured activity less than zero. Although negative activities have no physical significance, they do have statistical importance, as for example in the evaluation of trends or the comparison of two groups of samples.

To the extent practical, it is the policy of NAREL to report results as generated, whether positive, negative, or zero, together with the "2-sigma" measurement uncertainty and a sample-specific estimate of the minimum detectable concentration (MDC). The measurement result, uncertainty, and MDC are always expressed in the same unit of measurement.

### EVALUATION OF QC ANALYSES

A method blank result is considered unacceptable if it is more than 3 standard deviations below zero or more than 3 standard deviations above a predetermined upper control limit. For some analyses NAREL has set the upper control limit at zero. For others the control limit is a small positive number.

NAREL evaluates the results of duplicate and spike analyses using "Z scores." A Z score is the number of standard deviations by which the QC result differs from its ideal value. The score is considered acceptable if its absolute value is not greater than 3.

The Z score for a spiked sample is computed by dividing the difference between the measured value and the target value by the combined standard uncertainty of the difference.

The Z score for a duplicate analysis is computed by dividing the difference between the two measured values by the combined standard uncertainty of the difference. When the precision of paired MS/MSD analyses is evaluated, the native sample activity is subtracted from each measured value and the net concentrations are then converted to total activities before the Z score is computed.

Each standard uncertainty used to compute a Z score includes an additional fixed term to represent sources of measurement error other than counting error. This additional term is not used in the evaluation of method blanks.

NAREL reports the "relative percent difference," or RPD, between duplicate results and the "percent recovery," or %R, for spiked analyses, but does not use these values for evaluation.

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**SDG #1200016**

**ANALYSIS SUMMARY**

Analysis method: NAREL TH-EICHROM  
Title: Actinides (Thorium) by Extraction Chromatography

NAREL Sample #	Client Sample ID	QC Type	Date Completed	Preparation Batch #	Assay Batch #
B2.05495G	FB22		06/06/2012	0008793W	0016023P
B2.05496H	HW64		06/06/2012	0008793W	0016023P
B2.05497J	FB23		06/06/2012	0008793W	0016023P
B2.05498K	HW63Z		06/06/2012	0008793W	0016023P
B2.05499L	HW62		06/06/2012	0008793W	0016023P
B2.05499L	HW62	DUP	06/06/2012	0008793W	0016023P
B2.05500K	HW63		06/06/2012	0008793W	0016023P
LCS-00639476E *		LCS	06/06/2012	0008793W	0016023P
RBK-00639475D *		RBK	06/06/2012	0008793W	0016023P

\* Samples marked with an asterisk are not in this sample delivery group but were analyzed with it for QC purposes.

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**SDG #1200016**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	B2.05495G	Amount analyzed:	2.500e-01 L
Client sample ID:	FB22	Preparation batch #:	0008793W
Matrix:	WATER-DRINKING	Assay batch #:	0016023P
Collected:	2012-05-22 11:58 EDT	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	N/A	Analyst:	AS
Ash/dry weight:	N/A	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
06/05/2012 16:03	1000.0	AS82	GVJ

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	2.27e-02	6.6e-02	9.8e-02	PCI/L	06/04/2012 14:27 CDT
Th228	7.39e-02	7.7e-02	1.1e-01	PCI/L	06/04/2012 14:27 CDT
Th230	3.69e-02	5.0e-02	5.3e-02	PCI/L	06/04/2012 14:27 CDT
Th232	4.10e-03	3.8e-02	8.1e-02	PCI/L	06/04/2012 14:27 CDT

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**SDG #1200016**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	B2.05496H	Amount analyzed:	2.500e-01 L
Client sample ID:	HW64	Preparation batch #:	0008793W
Matrix:	WATER-DRINKING	Assay batch #:	0016023P
Collected:	2012-05-22 11:10 EDT	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	N/A	Analyst:	AS
Ash/dry weight:	N/A	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
06/05/2012 16:03	1000.0	AS83	GVJ

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	0.00e+00	5.1e-02	1.1e-01	PCI/L	06/04/2012 14:27 CDT
Th228	3.53e-02	6.9e-02	1.2e-01	PCI/L	06/04/2012 14:27 CDT
Th230	6.17e-02	6.6e-02	7.6e-02	PCI/L	06/04/2012 14:27 CDT
Th232	4.40e-03	4.0e-02	8.7e-02	PCI/L	06/04/2012 14:27 CDT

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**SAMPLE ANALYSIS REPORT**

Lab sample #:	B2.05497J	Amount analyzed:	2.500e-01 L
Client sample ID:	FB23	Preparation batch #:	0008793W
Matrix:	WATER-DRINKING	Assay batch #:	0016023P
Collected:	2012-05-23 13:25 EDT	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	N/A	Analyst:	AS
Ash/dry weight:	N/A	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
06/05/2012 16:03	1000.0	AS84	GVJ

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	0.00e+00	4.8e-02	9.8e-02	PCI/L	06/04/2012 14:27 CDT
Th228	7.00e-02	7.2e-02	9.6e-02	PCI/L	06/04/2012 14:27 CDT
Th230	3.29e-02	5.1e-02	7.1e-02	PCI/L	06/04/2012 14:27 CDT
Th232	3.29e-02	5.1e-02	7.1e-02	PCI/L	06/04/2012 14:27 CDT

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**SAMPLE ANALYSIS REPORT**

Lab sample #:	B2.05498K	Amount analyzed:	2.500e-01 L
Client sample ID:	HW63Z	Preparation batch #:	0008793W
Matrix:	WATER-DRINKING	Assay batch #:	0016023P
Collected:	2012-05-23 13:10 EDT	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHRON
Dry/wet weight:	N/A	Analyst:	AS
Ash/dry weight:	N/A	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
06/05/2012 16:03	1000.0	AS85	GVJ

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	-1.58e-02	5.5e-02	1.5e-01	PCI/L	06/04/2012 14:27 CDT
Th228	8.14e-02	8.0e-02	1.1e-01	PCI/L	06/04/2012 14:27 CDT
Th230	5.14e-02	5.8e-02	5.6e-02	PCI/L	06/04/2012 14:27 CDT
Th232	1.28e-02	3.7e-02	5.5e-02	PCI/L	06/04/2012 14:27 CDT

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**SAMPLE ANALYSIS REPORT**

Lab sample #:	B2.05499L	Amount analyzed:	2.500e-01 L
Client sample ID:	HW62	Preparation batch #:	0008793 W
Matrix:	WATER-DRINKING	Assay batch #:	0016023 P
Collected:	2012-05-22 15:59 EDT	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	N/A	Analyst:	AS
Ash/dry weight:	N/A	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
06/05/2012 16:03	1000.0	AS86	GVJ

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	1.60e-02	7.2e-02	1.4e-01	PCI/L	06/04/2012 14:27 CDT
Th228	4.79e-02	8.5e-02	1.5e-01	PCI/L	06/04/2012 14:27 CDT
Th230	3.92e-02	5.3e-02	5.6e-02	PCI/L	06/04/2012 14:27 CDT
Th232	2.61e-02	4.6e-02	5.6e-02	PCI/L	06/04/2012 14:27 CDT

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**SDG #1200016**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	B2.05499L	Amount analyzed:	2.500e-01 L
Client sample ID:	HW62	Preparation batch #:	0008793 W
Matrix:	WATER-DRINKING	Assay batch #:	0016023P
Collected:	2012-05-22 15:59 EDT	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	N/A	Analyst:	AS
Ash/dry weight:	N/A	QC type:	DUP
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
06/05/2012 16:03	1000.0	AS87	GVJ

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	2.50e-02	7.3e-02	1.1e-01	PCI/L	06/04/2012 14:27 CDT
Th228	7.71e-02	8.0e-02	1.1e-01	PCI/L	06/04/2012 14:27 CDT
Th230	2.27e-02	4.9e-02	7.8e-02	PCI/L	06/04/2012 14:27 CDT
Th232	0.00e+00	2.9e-02	5.9e-02	PCI/L	06/04/2012 14:27 CDT

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**SDG #1200016**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	B2.05500K	Amount analyzed:	2.500e-01 L
Client sample ID:	HW63	Preparation batch #:	0008793W
Matrix:	WATER-DRINKING	Assay batch #:	0016023P
Collected:	2012-05-23 13:09 EDT	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	N/A	Analyst:	AS
Ash/dry weight:	N/A	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
06/05/2012 16:03	1000.0	AS88	GVJ

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	0.00e+00	4.8e-02	9.8e-02	PCI/L	06/04/2012 14:27 CDT
Th228	9.01e-02	9.8e-02	1.5e-01	PCI/L	06/04/2012 14:27 CDT
Th230	7.37e-02	6.6e-02	5.3e-02	PCI/L	06/04/2012 14:27 CDT
Th232	-8.18e-03	2.8e-02	8.0e-02	PCI/L	06/04/2012 14:27 CDT

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**SDG #1200016**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	LCS-00639476E	Amount analyzed:	1.000e+00 SAMP
Client sample ID:	N/A	Preparation batch #:	0008793W
Matrix:	N/A	Assay batch #:	0016023P
Collected:	N/A	Prep procedure:	N/A
Sample type:	N/A	Analysis method:	NAREL TH-EICHRM
Dry/wet weight:	N/A	Analyst:	AS
Ash/dry weight:	N/A	QC type:	LCS
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
06/05/2012 16:03	1000.0	AS91	GVJ

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	3.40e-03	1.5e-02	2.9e-02	PCI	06/04/2012 14:27 CDT
Th228	1.39e-02	1.5e-02	2.0e-02	PCI	06/04/2012 14:27 CDT
Th230	2.51e+00	1.9e-01	2.2e-02	PCI	06/04/2012 14:27 CDT
Th232	1.75e-02	1.6e-02	1.8e-02	PCI	06/04/2012 14:27 CDT

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**SDG #1200016**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	RBK-00639475D	Amount analyzed:	1.000e+00 SAMP
Client sample ID:	N/A	Preparation batch #:	0008793W
Matrix:	N/A	Assay batch #:	0016023P
Collected:	N/A	Prep procedure:	N/A
Sample type:	N/A	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	N/A	Analyst:	AS
Ash/dry weight:	N/A	QC type:	RBK
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
06/05/2012 16:03	1000.0	AS93	GVJ

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	1.10e-02	2.0e-02	2.4e-02	PCI	06/04/2012 14:27 CDT
Th228	2.10e-02	1.8e-02	2.2e-02	PCI	06/04/2012 14:27 CDT
Th230	2.60e-02	1.9e-02	1.7e-02	PCI	06/04/2012 14:27 CDT
Th232	0.00e+00	6.3e-03	1.3e-02	PCI	06/04/2012 14:27 CDT

**U.S. ENVIRONMENTAL PROTECTION AGENCY  
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**SDG 1200016**

**PREPARATION BATCH SUMMARY**

Preparation batch #: 0008793W  
Analysis method: NAREL TH-EICHROM  
Preparation procedure: N/A

NAREL Sample #	Client Sample ID	Analysis #	QC Type	Yield	$\pm 2 \sigma$ Uncertainty	Analyst
B2.05495G	FB22	00638939L		93.31 %	1.99 %	AS
B2.05496H	HW64	00638945J		86.70 %	1.87 %	AS
B2.05497J	FB23	00638951G		93.27 %	1.99 %	AS
B2.05498K	HW63Z	00638972M		91.68 %	1.96 %	AS
B2.05499L	HW62	00638957N		91.14 %	1.95 %	AS
B2.05499L	HW62	00639474C	DUP	84.62 %	1.83 %	AS
B2.05500K	HW63	00638963L		91.92 %	1.97 %	AS
LCS-00639476E *		00639476E	LCS	95.82 %	2.04 %	AS
RBK-00639475D *		00639475D	RBK	94.70 %	2.01 %	AS

\* Samples marked with an asterisk are not in this sample delivery group but were analyzed with it for QC purposes.

**QC RESULTS FOR BATCH 0008793W**

NAREL Sample #	Analysis #	QC Type	Analyte	%R	RPD	Z	Evaluation
B2.05499L	00639474C	DUP	TH227		43.9	0.18	PASS
B2.05499L	00639474C	DUP	TH228		46.8	0.50	PASS
B2.05499L	00639474C	DUP	TH230		53.3	-0.46	PASS
B2.05499L	00639474C	DUP	TH232		200.0	-0.96	PASS
LCS-00639476E	00639476E	LCS	TH230	99.1		-0.24	PASS
RBK-00639475D	00639475D	RBK	TH227				PASS
RBK-00639475D	00639475D	RBK	TH228				PASS
RBK-00639475D	00639475D	RBK	TH230				PASS
RBK-00639475D	00639475D	RBK	TH232				PASS